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A Study of Cheese Spreads and Dips

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A STUDY OF CHEESE SPREADS AND DIPS

by

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INTRODUCTION

Importance

Each year in the State of Utah, thousands of pounds of a number of varieties of bulk and packaged cheese are returned to the manufacturing plants from the stores and other distribution points. The main reasons are: broken wrapper or rind, crushed or otherwise mutilated package, and mold development.

At the present time much of this cheese is shipped out of the state for processing. The remainder is sold at drastically reduced prices. If this unmarketable returned cheese were changed in form with good consumer acceptance the industry would experience a real savings.

Purpose

The purpose of this study was to explore the possibilities of salvaging this returned product in the form of process cheese dips, and will include the following:

1. Desirable formulae of varieties of dips which may be developed from returned cheese.

2. Market acceptance.

3. Keeping quality or shelf life.

4. Types of containers used in merchandising.

REVIEW OF LITERATURE

History (31)

Processing cheese commercially originated in Europe during the latter eighteen hundreds. The German kachkaese, the Belgian and French cancaillote, the French and Swiss fondu, and the Welsh rarebit may be regarded as the forerunners. Their preparation by heating and stirring, with or without the addition of flavoring ingredients, resulted in a semi-fluid, viscous or melted cheese. In 1895, camembert cheese was first pasteurized and sealed in tin cans on a commercial scale.

The preservation of cheese by pasteurizing or sterilizing was first applied to soft cheese, which ripen quickly and remain in prime condition only for a limited period of time. This preserving treatment lengthened their prime condition and permitted export to distant countries. The hard type cheeses followed later. They were processed for more convenient retailing purposes rather than preservation.

Processing cheese in the United States was stimulated by World War I. At that time the demand for food products was so great that preservation, avoidance of waste and efficient distribution were imperative. Under these conditions processing operations were started independently by the J. L. Kraft and the Phenix Cheese Companies. These two organizations developed rapidly and later combined and grew to become the largest cheese processing and distributing organization in the world. Production organization has been so effective that a limited number of large cheese processing companies have dominated the industry, while in Europe the process cheese enterprises are small and numerous.

The main factors for the rapid growth of this industry are uniformity, packaging, and advertising. It is estimated now that at least one-third of all the cheese consumed in this country is processed.

Distinguishing characteristics of the three general classes of process cheese products (3)

Pasteurized process cheese is the food prepared by comminuting and mixing with the aid of heat and prescribed emulsifying agents one or more varieties of cheese into a homogenous plastic mass. Optional ingredients are: acidifying agents, cream, water, salt, and harmless artificial coloring.

The limits established for fat and moisture are near or identical to the limits imposed for the corresponding variety of natural cheese.

Emulsifying agents can be used in amounts up to three per cent of the weight of the process cheese.

The quantity of acid added must be such that the pH is not reduced below 5.3.

Omission of the acid and emulsifying agents yields a product called pasteurized blended cheese.

The fat derived from the cream used must be less than five per cent of the weight of the process cheese.

Properly labeled varieties may contain one or any mixture of two or more of the following: Any properly prepared cooked, canned, or dried fruit, vegetable, or meat.

Pasteurized process cheese food. This product differs from pasteurized process cheese as follows:

1. Increased amounts of cream, milk, skimmilk, cheese whey, skimmilk powder, cheese whey powder, or any mixture of two or more of these.
2. The moisture content does not exceed 44 per cent.
3. The fat content is not less than 23 per cent.
4. The pH may not be adjusted lower than 5.0 with added acid.

Pasteurized process cheese spread. This product differs from the other two classes as follows:

1. The moisture content cannot exceed 60 per cent.
2. The fat content must be at least 20 per cent.
3. One or more prescribed stabilizing agents may be added in such amounts that the total weight of the substances listed does not exceed .8 per cent of the weight of the product.
4. Prescribed sweetening agents may be added in a quantity necessary for seasoning.
5. Dried skimmilk and dried whey may be added.
6. The pH may be reduced to 4.0.

If emulsifying agents are omitted, the product is called pasteurized cheese spread.

There are no regulations or definitions available on cheese dip.

Processing procedure

Selecting cheese. Van Slyke and Price (37) state that the selection of the cheese for the blend is determined chiefly by age, acidity, flavor, texture, body and composition of the lots of cheese available.

Templeton and Sommer (31) report that aged cheese in cheese spreads gave better flavor but that very old cheese was likely to produce a grainy body; very young cheese gave a product too rubbery to spread. They further emphasized the necessity of having a flavor standard in mind. Cheese with physical defects can be salvaged by processing. The damaged parts can readily be removed by trimming. They conclude by stating that cheese, which experience has taught, will become defective on ripening can be used before it really becomes defective.

Van Slyke and Price (37) report that some of the fine volatile flavors of well aged cheese are lost in the processing operation. Some defective flavors are likewise lost in whole or in part. Fermented and fruity flavors may be dissipated while non-volatile flavors such as bitter, salty, and acid must be blended carefully so that the intensity of the flavor is reduced below the objectionable level. They conclude by stressing that feedy and unclean flavors may be used cautiously and weed flavored like leeks, are dangerous when used in any amounts.

Babel and Hammer (7) found that when aged cheese showing varying degrees of rancidity was used at the rate of 25 per cent of the blend, the cheese flavor of the finished product was actually increased and the rancid flavor could not be detected.

Trimming and grinding. Sommer and Templeton (31) describe the trimming procedure as follows: Only the surface layer which is inferior in flavor and possibly unclean is removed. Additional rind which may be dry and unpalatable can be salvaged because grinding and heating will remedy this condition. Besides using knives to remove the rind, another method is to soften the rind by exposing the cheese to steam for a short time and then removing the surface by scraping. They emphasize that the trimming should be done in a room entirely separated from the processing and packaging room, otherwise there may be troublesome contamination from mold laden air.

In reporting about the grinding operation, Sommer and Templeton (31) state casein shreders have been adopted for large-scale operations. These machines require little or no preliminary cutting. Power driven meat grinders fitted with fairly coarse press plates are used on a smaller scale production. Here the cheese must be cut into strips roughly two to three inches square. A spring steel wire with a handle fastened to each end is very satisfactory. Knives require more force in cutting because the cheese clings to the blade.

Blending. Van Slyke and Price (37) state that the selection of numerous vat lots of cheese for quality control is as desirable for the soft types of process as for the hard types. They further state that two or more varieties are often combined in the making of the soft types of cheese. One variety, like Cheddar or Cream Cheese, provides the bulk of the product while another variety of cheese or other substances are added for flavor.

In the manufacture of Geneva Cream Cheese, Dahlberg and Marquardt (10) used 25 per cent aged Cheddar cheese and 15 per cent Roquefort cheese in respective varieties. Meyer et. al. (25) report using 44.5 per cent aged Cheddar in spreads developed for the Army.

The addition of optional ingredients

Emulsifiers. The commercial manufacture of process cheese depends largely upon the use of certain salts which tend to prevent the separation of fat from the cheese during the heating operation (37).

Foster et. al. (14) state that these certain salts help dissolve the protein and emulsify the fat. They further state that this reaction helps give the finished product the smoothness that is desired. One or any mixture of the following emulsifying agents may be used (3): mono-sodium phosphate, di-sodium phosphate, depotassium phosphate, tri-sodium phosphate, sodium metaphosphate, sodium acid pyrophosphate, tetrosodium pyrophosphate, sodium citrate, potassium citrate, calcium citrate, sodium tartrate, and sodium potassium tartrate.

Sommer and Templeton (31) report that the fat emulsifying property of the salts is operative through their effect on the cheese proteins rather than on the fat directly. To be effective the salt must apparently be a good casein or cheese protein solvent, and must produce a solution that is quite viscous.

Habicht (16) has pointed out that in general, salts composed of monovalent basis and polyvalent acid radical are effective for this purpose. However, he concludes, aside from the valence, the specific properties of the acid radical are also important.

Templeton and Sommer (34) observed that cheese made with sodium citrate retained small air cells and that cheese without these air cells was coarse in body.

Van Slyke and Price (37) state that ordinary emulsifiers, like sodium citrate and di-sodium phosphate, are most commonly used at the rate of 1 to 2 per cent of the weight of the cheese in the batch. The new army Cheddar cheese spreads (25) contain slightly more than 4 per cent of the weight of the cheese in the batch. They use di-sodium phosphate exclusively.

Sommer and Templeton (31) recommend the use of di-sodium phosphate where cost is the guiding factor, however, sodium citrate most nearly offers all the desirable properties.

<u>Fruits</u>, <u>vegetables</u>, <u>and</u> <u>meats</u>. Process cheese varieties may contain any properly cooked, canned, or dried fruit, vegetable, or meat, but must be properly labeled. (3)

<u>Stabilizing agents.</u> The Code of Federal Regulations (3) states that cheese spreads may contain one or more of the following water retaining substances: locust bean gum, gum karaya, gum tragacinth, gelatin, carboxymethyl cellulose, algin, gaur gum, carrageenin, and oat gum.

Barker (8) states that in cheese spreads, a buffer is needed because of rapid gain or loss in acid or alkali, which leads to trouble with fermentation. A buffer or gum stabilizer retards or prevents the change in acid or alkali reaction of the spread. He further states that the three functions of a gum are: (1) as an emulsifying agent to prevent separation of the fat in the product, (2) as a moisture retaining agent, to prevent the cheese from drying out, and (3) as a thickening agent to give suitable texture and spreading qualities.

There are two types of gums that are used extensively by the cheese industry. One is gum Karaya and the other is Locust Bean Gum. Locust Bean Gum is far more popular than Karaya, because it is more stable and has greater absorbing power.

Sommer (30) reports that Gum Karaya is similar to Gum Tragacinth, but it is more highly colored. Gum Karaya is usually considered inferior and costs considerably less.

Mack (20) reports that sodium alginate is a satisfactory stabilizer for cheese spreads.

Experimental work by Dahlberg (9) shows that gelatin also is a desirable stabilizer for cheese spreads.

<u>Mold inhibitors</u>

Gooding (15) discovered in 1945 that certain of the a,B- unsaturated fatty acids are good fungistatic agents for food and food wrappers. Therefore, crotonic acid and its homologues fall into this category.

Deuel et. al. (11) report that sorbic acid, $CH_3.CH:CH.CH:CH.COOH$, is particularly well suited as a fungistatic agent in protecting cheese products. The reasons are: (1) A smaller concentration of sorbic acid is required to protect foods. (2) The a,B- unsaturated fatty acids are readily metabolizable like food fatty acid, while benzoic acid cannot be so utilized. Work by Deuel et. al. (12) shows that sorbic acid is metabolizable in exactly the same way as the natural saturated fatty acids such as Caproic acid, both yielding carbon-dioxide and water end products.

Sorbic acid (5) is an effective growth inhibitor for many yeasts, molds and for some bacteria. Sorbic acid should not be used to reduce the existing mold or yeast contamination present, but to retard their further growth, provided the degree of contamination is not too high. They continue by stating that the dehydrogenation of the fatty acids to the unsaturated fatty acids is one phase in the growth of molds in foods. This is accomplished by a dehydrogenating enzyme system, and without this reaction the mold cannot reproduce. Sorbic acid is an unsaturated fatty acid similar to those formed in the enzymatic dehydrogenation reaction, and when present in excess of the amount produced by the reaction, tends to inhibit the reaction and, consequently, the growth of mold.

The report further states that a sorbic acid solution may be added to a food product by blending, spraying, dipping or added as the dry powder, when adequate mixing facilities are available to insure uniform distribution. They recommend .01 to .1 per cent, or more.

Experimental work by Melnick (24) showed that cheese packaged in a wrapper with all surfaces treated with sorbic acid in the amount of 2.5 to 5.0 per 1000 sq. in. is adequately protected. Such wrappers will furnish not more than .1 per cent sorbic acid to the cheese. The same work revealed that in cheese with a high ratio of mold to sorbic acid concentration, oxidation of the sorbic acid is catalyzed to a marked degree but through the same mechanisms operating in the animal organism, beta oxidation to the next lower fatty acid homologue of even-number carbon atoms and finally to carbon dioxide and water.

The results of careful study by Melnick et. al. (22) show that sorbic acid migrates rapidly from wrapper into cheese. The per cent of initial sorbic acid which remains on the wrapper is variable but small, well under 10 per cent. Sorbic acid migrates into about the fifth slice of cheese, each slice one-eighth inch in thickness, in less than two weeks. The spedrophotometric method of estimation was used (21).

In another experiment conducted by Melnick et. al. (23) conclusive evidence showed that in packaged cheese held at 45°F. for a period of six weeks, oxidative deterioration of the added sorbic acid and of the naturally occurring poly unsaturated fatty acids does not occur. Also, sorbic acid cannot sublime through the wrapper into the surrounding atmosphere.

For the purpose of controlling mold growth in packaged cheese, Smith and Rollin (29) screened a large number of fungistatic agents by evaluating their effectiveness in protecting natural cheeses in moisture proof wrappers. Sorbic acid was found to be the most promising of all agents tested.

In the direct addition of sorbic acid to process American Cheese, the results shown in Table 1 were obtained (28). Thus, 0.01 per cent sorbic acid retarded mold and 0.05 per cent inhibited it completely in process cheese.

Sorbic acid	Observation after 17 days' storage at 45°F.			
	Sample 1	Sample 2	Sample 3	Sample 4
per cent				
Control (no sorbic acid).	++	+++	+++	++
0.005	++	++	++	++
0.01	+	0	+	-
0.05	-	-	-	-
0.10	-	-	-	-
0.15	-	-	-	-
0.2	-	-	-	-
0.5	-	-	-	-
1.0	-	-	-	-

* The samples were stored at 45°F. and removed for approximately one hour each day for examination; + indicates mold apparent, - indicates no mold, 0 indicates sample lost.

In later work, Smith and Rollin (29) revealed that taste tests of process cheese containing sorbic acid and of natural cheese which had been packaged in treated wrappers showed that there is no objectionable taste, odor or color imparted to the cheese by amounts of sorbic acid which are fungistatic.

The following approval has been given by the U. S. Food and Drug Administration as of January 1, 1957 (4):

> A pasteurized process cheese food in the form of slices or cuts in consumer sized packages may contain not more than .2 per cent by weight of sorbic acid. If a pasteurized process cheese food in sliced or cut form contains sorbic acid, the label shall bear the statement, added to retard mold growth, or added as a preservative.

Rosenberg and Nielsen (27) state, they have learned that the U. S. Food and Drug Administration in the light of experimental evidence has seen no cause to question the safety of sorbic acid for use in foods.

<u>Color</u>

Sommer and Templeton (31) report that in processing Cheddar or American cheese, which contains added color, excessive heating should be avoided, otherwise, the color will change from the typical cheese color to one that has been described as "salmon pink".

Barker (8) states that the use of butter color in combination with cheese color in process cheese spreads and dressings does a lot to make a uniform color. Butter color is never diluted, but added a little at a time. Cheese color and butter color should never be mixed together, other than as they are mixed in the cheese itself. Adding cheese color to butter color will cause an undesirable color reaction. Barker concludes his report by stating that butter color blends perfectly and is not subject to the same color changes as cheese color alone, however the two colors should be manufactured by the same company.

Temperature of heating

Van Slyke and Price (37) report that higher temperatures of processing and packaging are used for cheese foods and spreads than are commonly used for the hard types of process cheese. These higher temperatures give improved keeping properties to these more perishable products.

Templeton and Sommer (34) recommend temperatures of 160°F. to 180°F. to destroy heat resistant and putrefactive organisms. These organisms, they pointed out, were introduced by the addition of sweet cream to the batches and their growth was encouraged by low acidity of the cheese spreads.

Van Slyke and Price (37) state that temperatures of 160°F. to 190°F. are commonly used in processing the softer varieties of cheese spreads.

The procedure outlined by Meyer et. al. (25) calls for heating the Cheddar type spreads to a temperature range of 165°F. to 175°F. and then sterilizing the product for mixing at a temperature range of 280°F. to 292°F. for 20 seconds. Their results showed that the spreads produced by this new method were superior to those produced by ordinary pasteurizing processes.

Federal standards (3) require that the heat treatment be no less than 150°F. for at least 30 seconds.

Bacteria problem

The work of Hood and Smith (17) revealed that relatively few bacteria other than spore formers survive the pasteurization of processed cheese varieties, and of these remaining, the anaerobic species are most likely to grow.

Foster et. al. (14) state that Clostridium sporogenes has been reported as the most common cause of process cheese spoilage. Also Clostridium pasteurianum and others have caused trouble. They further state that processed cheese products containing skimmilk powder, whey powder, pimento, or other sugar containing foods are more likely to undergo spoilage by Clostridia because the added sugar may permit growth of the organisms that otherwise could not develop.

Van Slyke and Price (37) agree that spore forming organisms survive the heat treatment of processing and some may cause gas development in the finished cheese if conditions for their growth are favorable. Chief among such conditions should be mentioned: heavy contamination, high temperature, low salt concentration, and pH levels above 5.3-5.6.

Albus and Ayers (1) showed that spore forming organisms caused gassy fermentation of process cheese containing pimentos. Pimentos provided a fermentable sugar. When this sugar was removed by washing, the defect was prevented.

Meyer et. al. (25) report that microbiological studies conducted on their ultra high heat-treated cheese spread samples have failed to reveal a consistent pattern of viable organisms in the samples. Although no sign of spoilage had occurred in 20 months.

Homogenizing

Van Slyke and Price (37) state that homogenizing of the hot batches is feasible when sufficient fluidity is attained by addition of large amounts of cream cheese curd, or sweet cream in the blend. This treatment produces extremely smooth consistency in the finished product. They recommend 1000 to 3000 pounds pressure.

Dahlberg and Marquardt (10) homogenized Geneva Cream Cheese at 3500 pounds pressure with excellent results.

Van Slyke and Price (37) warn that the use of the homogenizer introduces a possibility of contamination in the manufacture of cheese spreads. They recommend that the machine be carefully taken apart and cleaned after each run and should be sterilized by pumping 160°F. water through it immediately before use.

Packaging

Foster et. al. (14) state that the hot mass of cheese is caused to flow into plastic or foil-lined cartons of convenient size and are then sealed to exclude air.

Van Slyke and Price (37) report that spreads are commonly packaged in glass containers with a vacuum sealed closure.

Eldred (13) reports that process cheese items are packaged in glass, plastic, tin, cardboard, and foil containers.

METHOD OF PROCEDURE

General information

The cheese for this problem was furnished by the Nelson Ricks Creamery Company and the Utah State University Creamery. All of the equipment and other ingredients were furnished by the U.S.U. Creamery.

Most of the cheese used had been returned to the Nelson Ricks Creamery Company from their distribution points because of physical defects; mainly, broken wrappers or rind, and mold development. The size of the packages varied from four oz. Blue wedges to twenty-three lb. Cheddar daisys. The varieties received included mild and aged Cheddar, Blue, Monterey, and Swiss.

The milk products used were obtained from sweet cream containing 33 per cent butterfat, skimmilk containing .09 per cent milk solids not fat, and N.D.M.S.

Processing steps

1. The cheese was first sorted as to variety and age.

2. Next came the selection and trimming of the proper amount for the batch.

3. The cheese was then cut into small pieces, two to three inches square with a 12-inch stainless steel knife and the pieces forced through a Hobart model 2232 grinder.

4. All of the blending and heating was done in five and ten gallon milk cans in a direct steam injection water bath with the exceptions of trial five with Process Blue Cream Dip and trial six and seven with Process Cheddar Cream Dips. These three batches were

blended and heated in a Cherry-Burrell Unavat, model U50M.

5. The Process Cheese Dips were pumped through a Manton-Gaulin 300 CGC Homogenizer.

6. Two types of containers were used: 16 oz. Canco enameled tin cans and 10 oz. Kaiser aluminum foil containers with plastic lids. They were filled with an Anderson No. 10327 hand operated filler. The cans were sealed with an Automatic Master-Sealer hand operated can sealer and the plastic lids were placed on the aluminum foil containers by hand.

Due to the small quantity of 10 oz. aluminum foil containers available for this experiment their use was limited to Trials 4 and 5 with Blue Cream Dip, Trials 4 and 5 with Cheddar Cream Dip and Trial 1 with Swiss Cream Dip.

Consumer preference tests were conducted on three different occasions at the U. S. U. Creamery sales room and at two banquets. The varieties were tested on potato chips and crackers. The samples were judged according to choice on the following type ballot:

WHAT'S YOUR PREFERENCE IN CHEESE DIPS?

First ______________________

Second ______________________

Third ______________________

Fourth ______________________

Fifth ______________________

General procedure

The cream and skimmilk were first placed in the can or vat and the steam turned on. At this point the salt, citric acid, sodium citrate and locust bean gum (and sorbic acid if used), which had been thoroughly mixed in a paper sack, were added to the cream and skimmilk and completely incorporated with the aid of a stainless steel stirring rod. At approximately 80°F. the skimmilk powder (N.D.M.S.) was added slowly and thoroughly mixed in.

The ground cheese was added at a temperature of approximately 120°F. and was completely melted and blended into the mix by the time 165°F. was reached (an average of 20 minutes). At 165°F. the Dariloid (sodium alginate) was added, mixed with one-half pint of cold water and completely incorporated by vigorous stirring for several minutes. After the desired pasteurization time, the process cheese product was homogenized and packaged.

The filled cans and foil packages were then washed with 100°F. water, marked and placed in a cooler with a temperature range of 36°F. to 40°F. At later intervals some of the filled packages were placed in the laboratory (80°F.) and hardening room (0 to -10°F.) for quality comparisons.

All the equipment was cleaned thoroughly after each batch. Immediately before use, 160°F. water was pumped through the homogenizer and the containers and other equipment were rinsed with hot water (at least 160°F.). The containers were rinsed again with a chlorine solution (200 P.P.M.). Strict rules of sanitation were observed and precautions maintained in all of the processing steps to avoid contamination.

The information for the completion of this problem was obtained by conducting separate experiments on Process Blue Cheese Dips, Process Cheddar Cheese Dips, and Process Swiss Cheese Dips. (Hereafter they will be termed Blue Cheese Dip, Cheddar Cheese Dip and Swiss Cheese Dip.)

To facilitate and clarify the methods used, the three types will be discussed separately.

Blue Cheese Dips

Trial 1 was conducted to test the formula for Blue Cheese Dip which was developed by modifying the Blue Cream Spread formula developed at the U. S. U. Creamery, and also compare the use of skimmilk as a substitute for cream in the formula.

Series I, Formula A. Blue Cheese Dip

Ingredients	Percent by weight
Skimmilk	69.50
N.D.M.S.	5.30
Blue Cheese (mixed lots)	24.70
Citric acid	.06
Locust bean gum	.185
Dariloid	.245
Salt	.123

Series I, Formula B. Blue Cheese Dip

Ingredients	Percent by weight
Cream	50.00
Skimmilk	20.00
Blue Cheese (mixed lots)	24.50
N.D.M.S.	5.00
Citric acid	.06
Locust bean gum	.124
Dariloid	.185
Salt	.123

The two batches were held at 165°F. for 30 minutes and homogenized at 3000 pounds pressures.

Trial 2 was conducted to decrease the intensity of the Blue Cheese flavor and to determine the proper amount of Dariloid to add to the product for the most desirable body characteristics.

Series I, Formula C. Blue Cheese Dip

Ingredients	Percent by weight
Cream	51.00
Skimmilk	20.50
Blue Cheese (mixed lots)	22.00
N.D.M.S.	5.50
Citric acid	.06
Locust bean gum	.124
Salt	.123
Horse radish	.123
Sodium citrate	.250

The product was blended and heated in one, ten gallon milk can (temperature of 160°F.). Then the batch was transferred equally into three, five gallon milk cans. They were placed in the water bath and heated to 165°F. where the following amounts of Dariloid were added:

Sample No.	Percent by weight of Dariloid
1	.185
2	.210
3	.235

The products were pasteurized at 165°F. for 30 minutes and homogenized at 3000 pounds pressure.

Seven cans were placed at 80°F. for keeping quality comparisons. All of the packaged products were checked daily for visable signs of gas production. One of the cans, at 80°F. was opened every other day for flavor and body examination. None of the cans held at 40°F. were opened the first week of storage. Commencing with the second week, one can was opened every four days for flavor and body examination. This procedure will be termed the regular keeping quality examination.

Trial 3 was conducted to further decrease the intensity of the Blue Cheese flavor and develop different varieties of dip using a Blue Cheese base.

Series I, Formula D. Blue Cheese Dip

Ingredients	Percent by weight
Cream	52.00
Skimmilk	21.50
N.D.M.S.	5.50
Blue Cheese (mixed lots)	20.00
Citric acid	.093
Locust bean gum	.123
Dariloid	.210
Salt	.123
Horse radish	.123
Sodium citrate	.200

The batch was heated to 170°F. for 30 minutes and homogenized at 3000 pounds pressure.

The varieties developed were:

Sample No.	Name of Product	Ingredients
1	Blue Cheese Dip with minced clams	5.0 Blue Cheese Dip (base) .5 minced clams 1 tsp. garlic oil 1 tsp. horse radish 1 pinch cayenne pepper
2	Blue Cheese Dip with minced clams	5.0 Blue Cheese Dip (base) 1.0 minced clams 1/2 tsp. garlic oil 1 tsp. horse radish 1 pinch cayenne pepper
3	Blue Cheese Dip (garlic flavor)	5.0 Blue Cheese Dip (base) 1 T. garlic oil

The blending of the added ingredients was done in one gallon glass jugs. The 5.0 lbs. base was weighed first and the ingredients was added and blended with the aid of a large stainless steel spoon.

Only two cans of each sample were available for 80°F. storage and were not opened until gas production was evident.

Trial 4 was conducted for a threefold purpose:

1. To test sorbic acid as a mold inhibitor in Blue Cheese Dip.

2. To test aluminum foil containers in packaging the product.

3. To test the keeping quality in aluminum foil and tin can containers at various temperatures.

No change was made in the formula. The batch was divided into two, five gallon milk cans and sorbic acid in the amount of .20 percent was added to lot 2. Both lots were heated to 175°F. for 30 minutes; cooled to 160°F. and homogenized at 3000 pounds pressure.

The procedure is further outlined as follows:

Blue Cheese Dip

80.5 lb. batch

Lot 1	Lot 2 .20% sorbic acid
1. 10 oz. Alum. foil containers Storage temp. 80°F. 40°F. 0°F. No. of containers 2 4 2	1. 10 oz. Alum. foil containers Storage temp. 80°F. 40°F. 0°F. No. of containers 2 4 2
2. 16 oz. cans Storage temp. 80°F. 40°F. 0°F. No. of containers 9 24 3	2. 16 oz. cans Storage temp. 80°F. 40°F. 0°F. No. of containers 9 24 3
Total 40 lbs.	Total 40 lbs.

The regular procedure for the keeping quality examination of the cans was followed. However, due to the small number of aluminum foil containers available for the problem, the same frequent opening for flavor and body examination was not permitted.

The filled containers stored at 0°F. to -10°F. were not examined periodically because of their frozen condition. The samples were removed and thawed out at the time of the general examination of both lots by the two judges.

Trial 5 was conducted to duplicate Trial 4, with the following changes:

1. The product was heated as high as possible in the water bath (180°F. for 30 minutes).

2. .15 percent sorbic acid was used.

3. No samples were placed at 0°F.

Trial 6 was conducted to decrease the intensity of the Blue Cheese flavor and to attempt to heat the product to a higher temperature.

Series I, Formula E. Blue Cheese Dip

Ingredients	Percent by weight
Cream	52.50
Skimmilk	22.25
N.D.M.S.	5.75
Blue Cheese (mixed lots)	18.50
Citric acid	.100
Locust bean gum	.185
Dariloid	.220
Salt	.150
Horse radish	.123
Sodium citrate	.185

From the time the Dariloid was added (165°F.), 30 minutes was required to reach 195°F. (highest temperature possible), After 10 minutes at 195°F., 35 lbs. was removed from the vat in a 5 gallon can and placed in the water bath and cooled to 160°F. The remainder was held at 195°F. for a total of 30 minutes. The product was then cooled to 160°F. and both lots were homogenized at 80°F. and the regular examination procedure followed.

Cheddar Cheese Dips

Trial 1 was conducted to test the formula for Cheddar Cream Dip which was developed by modifying the Blue Cream Spread formula developed at the U. S. U. Creamery.

Series II, Formula A. Cheddar Cheese Dip

Ingredients	Percent by weight
Cream	58.00
Skimmilk	7.00
N.D.M.S.	5.00
Cheddar Cheese (nippy)	21.00
Cheddar Cheese (mild)	8.50
Citric acid	.116
Locust bean gum	.174
Dariloid	.233
Salt	.116
Sodium citrate	.290

The product was pasteurized at 165°F. for 30 minutes and homogenized at 3000 pounds pressure. Seven cans were placed at 80°F. and the regular examination procedure followed.

Trial 2 was conducted to develop different varieties of Cheddar Cheese Dip.

The formula was not changed. Varieties developed were:

Sample No.	Name of Product	Ingredients
1	Cheddar Cheese Dip	No additions
2	Cheddar Cheese Dip with dates and nuts	5.0 lbs. Cheddar Cheese Dip (base) .25 lbs. dates (ground) .25 lbs. walnuts (ground)
3	Cheddar Cheese Dip (garlic flavor)	5.0 lbs. Cheddar Cheese Dip (base) 1 tsp. garlic powder or 1 lb. garlic oil
4	Cheddar Cheese Dip with pimento	5.0 lbs. Cheddar Cheese Dip (base) .25 lbs. pimento (ground) ¼ tsp. cayenne pepper
5	Cheddar Cheese Dip with pimento	5.0 lbs. Cheddar Cheese Dip (base) .50 lbs. pimento (ground) ¼ tsp. cayenne pepper
6	Cheddar Cheese Dip (onion flavor)	5.0 lbs. Cheddar Cheese Dip (base) 1½ tsp. onion pepper
7	Cheddar Cheese Dip with minced clam	5.0 lbs. Cheddar Cheese Dip (base) .50 lbs. minced clam ½ tsp. garlic oil 1 tsp. horse radish 1 pinch cayenne pepper

The Cheddar Cheese base was pasteurized at 165°F. for 30 minutes and homogenized at 3000 pounds pressure.

A Universal No. 2 hand operated portable food grinder was used to prepare the dates, nuts, and pimentos. The 5.0 lbs. Cheddar Cheese Dip base was weighed into 1 gallon glass jugs. The ingredients were then added and thoroughly incorporated with the aid of a large stainless steel spoon.

Only two cans of each variety were available for storage at 80°F. They were not opened until gas production was evident.

Trial 3 was conducted to determine the keeping quality of Cheddar Cheese Dip (with pimento) after various heating and handeling procedures.

The formula was not changed. The product was pasteurized at 165°F. for 30 minutes and homogenized at 3000 pounds pressure.

The batch was divided as follows:

Repasteurized after Homogenization

Sample number	lbs. and	addition of Pimento	Pimentos washed
1	10	no	no
2	10	no	yes
3	10	yes	no
4	10	yes	yes

The repasteurization temperature and time was 165°F. for 20 minutes. Samples 2 and 4 were washed with cold water before grinding. Four cans of each sample were placed at 80°F. for keeping quality comparisons. The regular examination procedure was followed.

Trial 4 was conducted for a three-fold purpose:

1. To test sorbic acid as a mold inhibitor in cheddar cheese dips.
2. To test aluminum foil containers in packaging the product.
3. To test the keeping quality in aluminum and tin can containers at various temperatures.

The mild cheddar cheese in the formula was replaced by nippy cheddar.

The batch was divided in half and 2, 5 gallon milk cans used. .15 per cent sorbic acid was added to lot 2. Both lots were heated to 175°F. for 20 minutes, cooled to 160°F. and homogenized at 3000 pounds pressure.

The procedure is further outlined as follows:

Cheddar Cheese Dip

84.0 lb. batch

Lot 1	Lot 2 .15% sorbic acid
1. 10 oz. Aluminum foil Storage Temp. 80°F. 40°F. 0°F. No. containers 2 4 2	1. 10 oz. Aluminum foil Storage Temp. 80°F. 40°F. 0°F. No. of containers 2 4 2
2. 16 oz. cans Storage Temp. 80°F. 40°F. 0°F. No. containers 9 24 3	2. 16 oz. cans Storage Temp. 80°F. 40°F. 0°F. No. of containers 9 24 3

Four of the foil containers were sealed with parafin wax for a keeping quality comparison.

The regular procedure of examining the cans was followed. However, due to the small number of aluminum foil containers available for the problem, the same frequent opening for the body and flavor examination was not permitted. The filled containers stored at 0° to -10°F. were examined just once. The samples were removed and thawed out at the time of the general examination of both lots by the two judges.

Following the examination, the opened cans were covered with wax papers and secured with elastics. They were marked and then placed back in the cooler, where they were checked daily for mold development.

Trial 5 was conducted to duplicate Trial 4 with the following changes:

1. The product was heated as high as possible in the water bath (180°F. for 30 minutes).
2. .10% sorbic acid was used.
3. No samples were placed at 0°F.

Trial 6 was conducted to heat the product to the highest temperature possible.

Series II, Formula B. Cheddar Cheese Dip

Ingredients	Percent by weight
Cream	58.00
Skimmilk	6.50
N.D.M.S.	5.00
Cheddar cheese (nippy)	30.00
Citric acid	.150
Locust bean gum	.180
Dariloid	.233
Salt	.125
Sodium citrate	.300

Sorbic acid was not available for this trial.

From the time the Dariloid was added (165°F.), 30 minutes time was required to reach 185°F. (highest temperature possible). The product was held at 185°F. for 30 minutes, cooled to 160°F. and homogenized at 3000 pounds pressure. Eight cans were placed at 80°F. The regular keeping quality procedure of examination was followed.

Trial 7 was conducted to test a new formula developed to strengthen the cheese flavor in Cheddar Cheese Dips.

Series II, Formula C. Cheddar Cheese Dip

Ingredients	Percent by weight
Cream	44.00
Skimmilk	9.50
N.D.M.S.	1.00
Cheddar Cheese	44.00
Citric acid	.150
Locust bean gum	.175
Dariloid	.120
Salt	.125
Sodium citrate	.660
Sorbic acid	.075

The product was heated to 185°F. (highest temperature possible) which required 30 minutes after the Dariloid was added at 165°F. It was held at 185°F. for 20 minutes, cooled to 160°F. and homogenized at 2200 pounds pressure. Eight cans were placed at 80°F. for the keeping quality comparisons. The regular procedure of examination was followed.

Trial 8 was conducted to correct the body defect of Formula C, series II.

Series II, Formula D. Cheddar Cheese Dip

Ingredients	Percent by weight
Cream	45.00
Water	11.00
Cheddar Cheese (aged)	44.00
Citric acid	.200
Locust bean gum	.175
Dariloid	.120
Salt	.135
Di-sodium phosphate	.660
Sorbic acid	.050
Color (butter)	.375

The product was heated to 174°F. and held for 20 minutes, cooled to 160°F. and homogenized at 3000 pounds pressure. Eight cans were stored at 180°F. and the regular procedure of examination followed.

Swiss Cheese Dips

Trial 1 was conducted to test the formula developed for Swiss Cheese Dip.

Series III, Formula A. Swiss Cheese Dip

Ingredients	Percent by weight
Cream	58.00
Skimmilk	7.00
N.D.M.S.	4.50
Swiss Cheese (mixed lots)	30.00
Citric acid	.116
Locust bean gum	.180
Dariloid	.200
Salt	.116
Sodium citrate	.300

The product was heated to 170°F. for 30 minutes and homogenized at 3000 pounds pressure. Six aluminum foil containers were filled, three sealed with parafin wax. Seven cans and three foil packages were stored at 80°F. with the regular examining procedure following.

Trial 2 was conducted to test the formula developed for Swiss and Blue Cheese Dip.

Series III, Formula B. Swiss and Blue Cheese Dip

Ingredients	Percent by weight
Cream	57.00
Skimmilk	7.00
N.D.M.S.	4.50
Swiss Cheese (mixed lots)	26.00
Blue Cheese (mixed lots)	5.00
Citric acid	.116
Locust bean gum	.170
Dariloid	.170
Salt	.116
Sodium citrate	.310
Sorbic acid	.100

The product was heated to 176°F. for 30 minutes and homogenized at 3000 pounds pressure. Seven cans were stored at 80°F. with the regular examining procedure following.

<u>The Analysis and Bacteriological Study of the Cheese Dips.</u>

The official method of the association of official agricultural chemists (18) was the method used in determining the moisture content of the cheese. The Mojonnier test for fat (26) was the method used in determining the fat content. The Beckman glass electrode pH meter was used in determining the pH of the cheese.

The Bacteria Counts were made according to Standard Methods (6) on each trial commencing with trial 2 of both the Blue and Cheddar Cheese Dips. The counts were taken shortly after the product was made and again after the samples of the same trial had been stored at 80°F. and gas development was evident. Test tubes with anaerobic agar were used to check each trial for anaerobic micro-organisms. Hucker's modification of the gram stain (32) was used to identify the bacteria.

To ascertain the viability of the organisms causing the gas production and foul odor in the product sealed in the cans and foil packages the following procedure was used: a two gram sample of the defective cheese was placed in a dilution blank and thoroughly mixed. One ml. of the solution was placed in each of 10 deep shake tubes containing 10 ml. of Nutrient Broth. The procedure was repeated using 10 ml. of anaerobic agar. The deep shake tubes were incubated at 30°C. for 48 hours. Next they were subjected to the following temperatures and time:

Number	1	2	3	4	5	6	7	8	9	10
Temp. °F.	190	200	210	220	225	230	235	240	245	250
Minutes	15	15	15	15	15	15	15	15	15	15

The 190°F. heating of the test tubes and contents was performed in the laboratory water bath. The remainder were heated in the autoclave.

The same entire procedure was applied to a .5 gram sample of N.D.M.S.

In conjunction with these tests, three sealed cans of both the Blue and Cheddar Cheese Dips were subjected to the following temperature and time.

Number	1	2	3	4	5
Temp. °F.	205	210	215	220	225
Time	15	15	15	15	15

One can was opened immediately for examination. The other cans were stored at 80°F. for the shelf life test.

RESULTS

Blue Cheese Dips

Series I included five formulae and six trials. Tables 2, 3, and 4 present the results and comparisons of the various formulae tested. Tables 5, 6, and 7 show the results of the experiments using sorbic acid in the product. All five formulae are presented below in Table 2. The important change through the trials was the decrease in the amount of Blue Cheese used in the formula from 24.7 percent to 18.5 percent. The amount of salt and citric acid were increased in the formulae D and E to lower the pH.

Table 2. Formulae for Blue Cheese Dips

Ingredients	A	B	C	D	E
		percent by weight			
Cream	----	50.00	51.00	52.00	52.50
Skimmilk	69.50	20.00	20.50	21.50	22.25
N.D.M.S.	5.30	5.00	5.50	5.75	6.00
Blue Cheese	24.70	24.50	22.00	20.00	18.50
Citric acid	.06	.06	.06	.093	.100
Locust bean gum	.185	.124	.124	.124	.185
Dariloid	.245	.185	.210	.210	.220
Salt	.123	.123	.123	.123	.150
Horse Radish	----	----	.123	.123	.123
Sodium citrate	----	----	.250	.200	.185

Table 3. Color, Flavor, Body and Texture Examination of Blue Cheese Dips

Formula	Number	Name of Product	Criticisms: Color	Criticisms: Flavor	Criticisms: Body and Texture
A	1	Blue Cheese Dip	Opaque, Dull	Blue cheese too pronounced	Harsh, lacks smoothness much too soft
B	1	Blue Cheese Dip	No criticism	Blue cheese too pronounced	Too soft
C	1	Blue Cheese Dip	No criticism	Blue cheese too pronounced	Too soft
	2	Blue Cheese Dip	No criticism	Blue cheese too pronounced	No criticism
	3	Blue Cheese Dip	No criticism	Blue cheese too pronounced	Too firm
D	1	Blue Cheese Dip (with minced clam)	No criticism	Mild clam	No criticism
	2	Blue Cheese Dip (with minced clam)	No criticism	Pronounced clam	No criticism
	3	Blue Cheese Dip (garlic flavor)	No criticism	No criticism	No criticism
E	1	Blue Cheese Dip	No criticism	No criticism	Lacks smooth appearance of No. 2
	2	Blue Cheese Dip	No criticism	No criticism	No criticism

Table 4. Keeping quality tests conducted with Blue Skim Dip and Blue Cheese Dips

Formula	Number	Name of Product	Pasteurization temp. °F.	Pasteurization time (min.)	pH	Shelf Life (days) 40°F.	Shelf Life (days) 80°F.
A	1	Blue Cheese Dip	165	30	5.75	22	6
B	1	Blue Cheese Dip	165	30	5.72	20	5
C	1	Blue Cheese Dip	165	30	5.80	22	4
D	1	Blue Cheese Dip (with minced clam)	170	30	5.68	17	3
	2	Blue Cheese Dip (with minced clam)	170	30	5.65	15	3
	3	Blue Cheese Dip (garlic flavor)	170	30	5.50	47	8
E	1	Blue Cheese Dip	195	10	5.20	56*	14
	2	Blue Cheese Dip	195	30	5.20	56*	16

* The elapsed time since the product was made is 56 days. To date no defect is evident.

Table 5 shows the only sample criticized to be lot 2 of trial 4 which product contained .20 percent sorbic acid. It seemed slightly darker in color to the judges and possessed a more intense Blue Cheese flavor than lot 1. However, sorbic acid flavor could not be detected. These criticisms did not appear when the amount of sorbic acid was decreased to .15 percent. There have been no signs of mold development in the lots containing sorbic acid in amounts from .10 to .20 percent. Also there was no mold development in the sealed aluminum foil containers, with or without sorbic acid.

Table 5. Inhibition by sorbic acid of molds in Blue Cheese Dip

Formula	Trial	Lot No.	Sorbic acid percent	pH	Mold Development (days)
C	4	1	0	5.72	13
	5	1	0	5.80	11
	4	2	.20	5.54	138*
	5	2	.15	5.63	130*
E	6	1	.10	5.50	45*
	6	2	.10	5.50	45*

* Represents number of days since product was made. To date no mold development is evident.

The keeping quality results are shown in Table 6. In all cases after the product was frozen, the body and texture was completely disrupted. Upon thawing there was considerable oiling off and the body was grainy or harsh. At 40°F. storage temperature the product containing sorbic acid had an extended shelf life of about 18 percent and at 80°F. storage temperature, the extended shelf life was about 30 percent.

Table 6. The effect of sorbic acid on keeping quality of Blue Cheese Dips

Formula	Trial	Lot No.	Sorbic Acid percent	pH	Pasteurization temp. °F.	Pasteurization time min.	Shelf Life (days) 0°F. Cans	0°F. Foil	40°F. Cans	40°F. Foil	80°F. Cans	80°F. Foil
C	4	1	0	5.72	170	30	0	0	68	66	6	6
	5	1	0	5.80	170	30	0	0	72	72	7	7
	4	2	.20	5.57	170	30	0	0	80	78	9	9
	5	2	.15	5.64	178	30	0	0	82	82	11	11
E	6	1	.10	5.50	195	10	—	—	56*	—	14	—
	6	2	.10	5.50	195	30	—	—	56*	—	16	—

* Figure represents the number of days since the product was made. To date no defect is evident.

Table 7. Color, flavor, body and texture examination of Blue Cheese Dips containing sorbic acid

Formula	Trial	Lot No.	Sorbic Acid percent	Criticisms		
				Color	Flavor	Body and Texture
C	4	1	0	No criticism	No criticism	No criticism
	5	1	0	No criticism	No criticism	No criticism
	4	2	.20	Slightly darker than lot 1	Blue cheese flavor more pronounced than lot 1	No criticism
	5	2	.15	No criticism	No criticism	No criticism
E	6	1	.10	No criticism	No criticism	No criticism

Cheddar Cheese Dips

Series II included four formulae and eight trials. Tables 8, 9, 10, and 11 present the results of the formulae tested. Tables 12, 13, and 14 present the results of the experiments using sorbic acid in the product.

The four formulae listed together in Table 8 are of two types. Most of the solids contained in formulae C and D are obtained from cheese while formulae A and B contain considerably less cheese and derive a high percentage of their solids from N.D.M.S. and cream. Within the types, over one-third of the cheese used in formula A is mild cheddar compared to 100 percent aged or nippy cheddar used in the other formulae. In formulae B the citric acid and salt content are stepped up and maintained or increased in the formulae that followed for the purpose of lowering the pH.

Table 8. Formulae for Cheddar Cheese Dip

Ingredients	A	B	C	D
	percent by weight			
Cream	58.00	58.00	44.00	45.00
Skimmilk	7.00	6.50	11.00	-----
Water	-----	-----	-----	11.00
N.D.M.S.	5.00	5.00	1.00	-----
Cheddar Cheese				
Nippy	21.00	30.00	44.00	44.00
Mild	8.50			
Citric acid	.116	.150	.150	.200
Locust bean gum	.174	.175	.175	.175
Dariloid	.233	.233	.120	.120
Salt	.116	.125	.125	.135
Sodium citrate	.290	.300	.660	.660
Color	-----	-----	.187	.375

The examination of the products is presented in Table 9. The body and texture of formulae A and B were not criticized. With the facilities available at the time, the dates, nuts and pimento could not be ground fine enough.

In a later experiment the pimento was ground as usual and then placed in a Hamilton Beech blender where it was reduced to puree form. This process eliminated the criticism for that product.

Formulas A and B did not contain enough cheese to give the product a desirable cheddar flavor. For this reason formulaes' C and D were developed. The desired flavor was present in formula C, however, it was much too viscous. This criticism was eliminated by removing a portion of the solids. The outcome of this final experimentation was formula D which possesses the desirable cheddar flavor and a body and texture closely resembling that of formulas A and B.

The results of the keeping quality comparisons of Cheddar Cheese Dips are presented in Table 10. When dates, nuts, and pimento were added after the product had been pasteurized, the shelf life was reduced considerably. When the pimentos were washed before grinding and then pasteurized in the Cheddar Cheese Dip (base) the shelf life was trippled (Table 11) as compared to the product that is not treated in this manner.

Table 9. Color, flavor, body and texture examination of Cheddar Cheese Dips

Formula	Number	Name of Product	Homo. P.P.	Criticisms		
				Color	Flavor	Body and Texture
A	1	Cheddar Cheese Dip	3000	No criticism	Flat, needs more Cheddar flavor	No criticism
	2	Cheddar Cheese Dip (with dates and nuts)	3000	No criticism	No criticism	Dates and nuts not chopped fine enough
	3	Cheddar Cheese Dip (garlic flavor)	3000	No criticism	No criticism	No criticism
	4	Cheddar Cheese Dip (with Pimento)	3000	No criticism	Pimento flavor not pronounced enough	Pimento not chopped fine enough
	5	Cheddar Cheese Dip (with Pimento)	3000	No criticism	No criticism	Pimento not chopped fine enough
	6	Cheddar Cheese Dip (onion flavor)	3000	No criticism	No criticism	No criticism
	7	Cheddar Cheese Dip (with minced clam)	3000	No criticism	No criticism	No criticism
B	1	Cheddar Cheese Dip	3000	Needs more color	Flat, needs more Cheddar flavor	No criticism
C	1	Cheddar Cheese Dip	2200 PP	No criticism	No criticism	Too viscous, resembles spread
D	1	Cheddar Cheese Dip	3000 PP	No criticism	No criticism	No criticism

Table 10. Keeping quality tests conducted with Cheddar Cheese Dips

Formula	Number	Name of Product	Pasteurization temp.	Pasteurization time	pH	Keeping Quality (days) 40°F.	Keeping Quality (days) 80°F.
A	1	Cheddar Cheese Dip	165	30	5.62	46	6
	2	Cheddar Cheese Dip (with dates and nuts)	165	30	5.82	18	4
	3	Cheddar Cheese Dip (garlic flavor)	165	30	5.60	44	6
	4	Cheddar Cheese Dip (with Pimento)	165	30	5.35	22	4
	5	Cheddar Cheese Dip (with Pimento)	165	30	5.25	19	4
	6	Cheddar Cheese Dip (onion flavor)	165	30	5.62	44	6
	7	Cheddar Cheese Dip (with minced clam)	165	30	5.55	21	4
B	1	Cheddar Cheese Dip	180	30	5.50	112*	8
	2	Cheddar Cheese Dip	183	30	5.47	94*	11
C	1	Cheddar Cheese Dip	184	30	5.45	32*	24
D	1	Cheddar Cheese Dip	174	30	5.28	24*	19

* Figure represents the number of days since the product was made. To date no defects are evident.

Table 11. Keeping quality comparison of Cheddar Cheese Dips (with pimento) with variation of procedure.

Sample	Repasteurization after Homogenization and Addition of Pimento	Pimentos washed	Shelf life (days) 40°F.	80°F.
1	no	no	12	3
2	no	yes	14	4
3	yes	no	26	5
4	yes	yes	38	7

The results of the experiments using sorbic acid in Cheddar Cheese Dips is presented in Tables 12, 13, and 14. Sorbic acid added to the product in amounts from .05 to .15 percent caused no noticeable defects as shown in the following table.

Table 12. Color, flavor, body and texture examination of Cheddar Cheese Dips containing sorbic acid

Formula	Trial	Lot No.	Sorbic acid percent	Criticisms: Color	Flavor	Body and Texture
A	4	1	0	No criticism	No criticism	No criticism
	5	1	0	No criticism	No criticism	No criticism
	4	2	.15	No criticism	No criticism	No criticism
	5	2	.10	No criticism	No criticism	No criticism
C	7	1	.075	No criticism	No criticism	No criticism
D	8	1	.050	No criticism	No criticism	No criticism

The results of the mold development comparisons as shown in Table 13 point out once again the outstanding inhibiting power of sorbic acid. To this date there is no sign of mold development in the products containing sorbic acid.

Table 13. Inhibition by sorbic acid of molds in Cheddar Cheese Dips

Formula	Trial	Lot No.	Sorbic acid percent	pH	Mold Development (days)
A	4	1	0	5.74	14
	5	1	0	5.70	16
	4	2	.15	5.62	134*
	5	2	.10	5.62	126*
C	7	1	.075	5.35	41*
D	8	1	.050	5.28	21*

* Figure represents number of days since product was made. To date no mold development is evident.

The shelf life comparisons are presented in Table 14. The same oiling off and graininess occurs when this product is frozen, as with Blue Cheese Dip. The product stored at 40°F. in both cans and foil containers, with or without sorbic acid is still satisfactory and a comparison is not possible. However, at 80°F. storage, the shelf life of the product containing sorbic acid in the amount of .10 percent is almost doubled, and the product containing .15 percent is more than doubled.

Table 14. The effect of sorbic acid on keeping quality of Cheddar Cheese Dips.

Formula	Trial	Lot No.	Sorbic Acid percent	pH	Pasteurization temp. F.	Pasteurization time min.	Shelf Life (days) 0 F. Cans	0 F. Foil	40 F. Cans	40 F. Foil	80 F. Cans	80 F. Foil
A	4	1	0	5.74	175	20	0	0	126*	126	8	7
	5	1	0	5.70	175	20	0	0	120*	120	9	9
	4	2	.15	5.62	175	20	0	0	126*	126	18	18
	5	2	.10	5.62	175	20	0	0	120*	120	18	17
C	7	1	.075	5.35	183	20	---	---	32*	---	21	---
D	8	1	.050	5.28	180	20	---	---	24*	---	22	---

* Figure represents number of days since product was made. To date no defect is evident.

Swiss Cheese Dip

Series III included two formulas and two trials. The two formulas are listed together in Table 15. The only defect present in the Swiss Cheese Cip (Table 16) was a deficiency of Swiss flavor. The other characteristics of the product were excellent.

Table 15. Formulas for Swiss and Swiss - Blue Cheese Dips

Ingredients	Swiss	Swiss-Blue
	percent by weight	
Cream	58.00	57.00
Skimmilk	7.00	7.00
N.D.M.S.	4.50	4.50
Swiss Cheese (aged)	30.00	26.50
Blue Cheese	----	5.00
Citric acid	.116	.116
Locust bean gum	.175	.170
Dariloid	.200	.170
Salt	.116	.116
Sodium citrate	.300	.310
Sorbic acid	----	.100

The shelf life tests as presented in Table 16 show that the product is still satisfactory after 161 days storage at 40°F. However, at 80°F. the keeping quality is a rather poor 9 days.

Table 16. Color, flavor, body and texture examination of Swiss Cheese Dip

Formula	No.	Homo. (pp.)	Criticisms: Color	Flavor	Body and Texture
A	1	3000	No criticism	Lacks Swiss Cheese flavor	No criticism

The Swiss and Blue Cheese Dip met all the examination requirements successfully as shown in tables 17, 18, and 19. It will only keep a relatively short time of 8 days at 80°F.

Table 17. Keeping quality tests of Swiss Cheese Dip

Formula	Number	Pasteurization temp. 0°F.	Time (min)	pH	Shelf Life (days) 40°F.	80°F.
A	1	170	30	5.50	161*	9

* The figure represents the number of days since the product was made. To date no defect is evident.

Table 18. Color, flavor, body and texture examination of Swiss and Blue Cheese Dip

Formula	No.	Homo. (pp.)	Criticisms: Color	Flavor	Body and Texture
B	1	3000	No criticism	No criticism	No criticism

Table 19. Keeping quality tests conducted with Swiss and Blue Cheese Dip

Formula	Number	Pasteurization temp. 0°F.	Time (min)	pH	Shelf Life (days) 40°F.	80°F.
B	1	176	30	5.55	92*	8

* The figure represents the number of days since the product was made. To date no defect is evident.

The average analysis of all the formulas tested are presented in table 20.

Table 20. Analysis of four types of Cheese Dip

Variety	Formula	Percent Moisture	Percent Fat
Blue Cheese Dip	B	58.61	24.32
	C	57.73	23.41
	D	58.16	23.39
	E	60.02	23.26
Cheddar Cheese Dip	A	51.60	28.98
	B	54.29	29.44
	C	50.24	29.19
	D	53.51	29.82
Swiss Cheese Dip	A	52.20	27.62
Swiss and Blue Cheese Dip	B	52.78	28.05

The results of all the plate counts taken are shown in Table 21.

Table 21. Standard Plate Counts of Cheese Dips

Variety	Trial	Before Storage		After Storage	
		1/100	1/1000	1/1000	1/10,000
Blue Dip	2	1,100	1,000	60,000	70,000
(minced clam)	3	1,900	4,000	TNC*	90,000
(garlic flavor)	3	1,200	2,000	51,000	60,000
Blue Dip	4-A	700	1,000	59,000	40,000
Blue Dip	4-B	500	1,000	39,000	50,000
Blue Dip	5-A	700	0	TNC	100,000
Blue Dip	5-B	700	1,000	52,000	70,000
Blue Dip	6	400	0	TNC	90,000
Cheddar Dip	2	900	2,000	58,000	50,000
(dates and nuts)	2	2,400	4,000	TNC	120,000
(minced clam)	2	1,500	1,000	TNC	140,000
(pimento)	2	1,200	1,000	56,000	80,000
(onion)	2	900	2,000	TNC	60,000
(garlic)	2	800	1,000	51,000	60,000
Cheddar Dip	3	500	0	43,000	30,000
Cheddar Dip	4-A	700	0	TNC	100,000
Cheddar Dip	4-B	800	0	TNC	90,000
Cheddar Dip	5-A	1,000	1,000	TNC	90,000
Cheddar Dip	5-B	400	0	22,000	20,000
Cheddar Dip	6	600	1,000	TNC	80,000
Cheddar Dip	7	300	0	------*	------
Cheddar Dip	8	400	0	------*	------
Swiss Dip		800	0	49,000	40,000
Swiss & Blue Dip		500	0	33,000	40,000

* Second count not taken, no gas production evident.
* Too numerous to count.

When ingredients were added after the product had been pasteurized, the bacterial counts were higher in all cases, especially in the samples where dates and nuts, minced clam and pimento were added.

Microscopic observation revealed that the bacterial colonies present in the plate counts were one type of organism which is described as follows: relatively large gram positive spore forming rods, occurring singly, in pairs, and in long chains. The spores were illipsoidal to cylindrical and some bulged the sporangium.

Microscopic observation of the bacterial colonies present in the anaerobic agar revealed one type of organism which is described as follows: gram negative slender rod shaped organism with terminal spores. The aerobic organisms were far more numerous in the product than the anaerobic type, which were only found present in three of the trials.

Table 22 shows that some of the organisms causing gas production in the Cheese Dips can withstand a temperature as high as 230°F. to 235°F. for fifteen minutes.

Table 22. Viability tests of aerobic spore forming organisms in Cheese Dips

Trial 1										
Number	1	2	3	4	5	6	7	8	9	10
Temp. °F.	190	200	210	220	225	230	235	240	245	250
Time (min)	15	15	15	15	15	15	15	15	15	15
Reaction	+	+	+	+	+	+	0	0	0	0

However, the identical test conducted on a different trial revealed less viable organisms as shown in Table 23.

Table 23. Viability tests of aerobic spore forming organisms in Cheese Dips

Trial 2										
Number	1	2	3	4	5	6	7	8	9	10
Temp. °F.	190	200	210	220	225	230	235	240	245	250
Time (min)	15	15	15	15	15	15	15	15	15	15
Reaction	+	+	+	0	0	0	0	0	0	0

The organisms found in the N.D.M.S. used in the cheese dips withstood a temperature up to 220°F. as shown in Table 24, and at least 210°F. as shown in Table 25.

Table 24. Viability tests of aerobic spore forming organisms in N.D.M.S.

Trial 1										
Number	1	2	3	4	5	6	7	8	9	10
Temp. °F.	190	200	210	220	225	230	235	240	245	250
Time (min)	15	15	15	15	15	15	15	15	15	15
Reaction	+	+	+	+	0	0	0	0	0	0

Table 25. Viability tests or aerobic spore forming organisms in N.D.M.S.

Trial 2										
Number	1	2	3	4	5	6	7	8	9	10
Temp. °F.	190	200	210	220	225	230	235	240	245	250
Time (min)	15	15	15	15	15	15	15	15	15	15
Reaction	+	+	+	0	0	0	0	0	0	0

No colonies of the anaerobic organisms were found in the anaerobic media inoculated and incubated with defective cheese. However, several colonies appeared in the N.D.M.S. samples but were unable to withstand a temperature above 190°F. for 15 minutes.

When the cheese dips in sealed cans were heated in the autoclave, the following information was revealed:

1. The body and texture of Blue Cheese Dip was disrupted similar to the freezing reaction when the product was heated above 210°F. for 15 minutes.
2. This same reaction occurs in Cheddar Cheese Dip when heated above 220°F. for 15 minutes.
3. The gas producing organisms present in these products were not killed.

The consumer ratings of the Cheese Dips are shown in Tables 26 - 30.

The three ratings conducted at the U. S. U. stand are presented in Tables 26, 27, and 28.

Table 26. Consumer ratings on five varieties of Cheese Dip

Rating	Blue (plain)	Cheddar (plain)	Cheddar (pimento)	Cheddar (onion)	Cheddar (garlic)
1	23	4	17	4	7
2	17	8	14	6	10
3	9	13	15	7	11
4	4	11	5	20	15
5	2	19	4	18	12

Table 27. Consumer ratings on five varieties of Cheese Dip

Rating	Blue (plain)	Cheddar (plain)	Cheddar (pimento)	Cheddar (onion)	Cheddar (garlic)
1	25	9	19	7	11
2	19	13	19	8	12
3	14	21	18	9	9
4	8	10	11	23	19
5	5	18	4	24	20

Table 28. Consumer ratings on three varieties of Cheese Dip

Ratings	Blue (plain)	Cheddar (plain)	Cheddar (garlic)
1	30	8	20
2	17	22	12
3	8	25	23

In all cases Blue Cheese Dip was selected as the favorite and Cheddar Cheese Dip with pimento followed second in the two ratings where it participated. The plain cheddar and garlic flavored cheddar cheese dips competed quite closely for third place with the onion flavored variety coming last in both cases.

Tables 29 and 30 show the results of two ratings conducted at group outings. The Blue Cheese Dip was chosen number one in Table 29. However, on a different occasion it was edged out by the Cheddar Cheese Dip with pimento as shown in Table 30. The garlic flavored Blue Cheese Dip was rated at the bottom and criticized by the majority as not being a desirable flavor combination. The Swiss Cheese Dip was criticized heavily as shown in Table 30 for not having enough Swiss flavor.

Table 29. Consumer ratings on five varieties of Cheese Dip

Ratings	Blue (plain)	Blue (garlic)	Cheddar (plain)	Cheddar (pimento)	Cheddar (garlic)
1	15	1	5	9	4
2	11	2	6	9	6
3	5	4	15	6	4
4	2	12	8	4	8
5	1	15	0	6	12

Table 30. Consumer ratings on five varieties of Cheese Dip

Ratings	Blue (plain)	Cheddar (plain)	Cheddar (pimento)	Cheddar (garlic)	Swiss (plain)
1	14	6	15	7	0
2	9	12	16	4	1
3	10	10	8	6	8
4	7	9	0	15	11
5	2	5	3	10	22

CONCLUSIONS

On the basis of the data obtained, the following conclusions are presented:

1. Returned cheese can be used in making satisfactory cheese dips.

2. The following formulae were most acceptable:

   Blue Cheese Dip
   Cheddar Cheese Dip
   Swiss Cheese Dip
   Swiss and Blue Cheese Dip

3. From the results of this project it is recommended that products used for flavoring not be added after the pasteurization operation. Also the adding of meat and fish products to the cheese dip base is a questionable practice. It would be much safer to add such products just previous to serving.

4. Pimento puree gave a smoother more desirable body and texture when pasteurized and homogenized with the Cheddar Cheese Dip base. The keeping quality was also improved.

5. Where cost is a guiding factor, sodium citrate can be replaced by di-sodium phosphate as the emulsifier.

6. The factors responsible for the improved shelf life were: increased pasteurization temperatures, lowering of the pH, and the addition of sorbic acid to the products. Best results were obtained by heating the cheese dips to a temperature of 185°F. or above for thirty minutes, and the lowering of the pH to as close to 5.0 as possible. Sorbic acid checked mold development and lowered the pH approximately .1 for every .1 percent added to the formulae.

7. Two types of organisms survived the heat treatment and caused gas production in the cheese dips. Aerobic sporeformers from the genus Bacillus were the most prevelent and occasionally anaerobic sporeformers from the genus Clostridium were found. Further tests to determine the species of these organisms were not conducted.

8. Results show that when the acceptable formulae were followed, the products remained satisfactory for at least five months under refrigeration. There is no doubt that the cheese dips, when properly made, will keep at least a year under refrigeration.

9. One source of the gas producing organisms seemed to be the N.D.-M.S. When the amount of this product used was reduced considerably or removed from the formula entirely, the keeping quality was improved. Further study is needed to determine the other sources of these organisms.

10. The gas producing organisms may not be destroyed with conventional methods, without frequent damage to the flavor, body and texture of the products; therefore, cheese dips have a much improved keeping quality when stored under refrigeration.

Blue Cheese Dip

Ingredients	percent by weight
Cream	52.50
Skimmilk	22.25
N.D.M.S.	5.75
Blue Cheese	18.50
Citric acid	.100
Locust bean gum	.185
Dariloid	.220
Salt	.150
Horse radish	.123
Sodium citrate	.185
Sorbic acid	.100

Cheddar Cheese Dip

Ingredients	percent by weight Mild Cheddar	 Pronounced Cheddar
Cream	58.00	45.00
Skimmilk	6.50	-----
Water	-----	11.00
N.D.M.S.	5.00	-----
Cheddar Cheese	30.00	44.00
Citric acid	.150	.200
Locust bean gum	.180	.175
Dariloid	.233	.120
Salt	.125	.125
Sodium citrate or Di-sodium phosphate	.300	.660
Sorbic acid	.050	.050
Color (butter)	.375	.375

Swiss Cheese Dip

Ingredients	percent by weight
Cream	45.00
Water	11.00
Swiss Cheese	44.00
Citric acid	.200
Locust bean gum	.175
Dariloid	.120
Salt	.135
Sodium citrate or Di-sodium phosphate	.660
Sorbic acid	.050
Color (butter)	.375

Swiss and Blue Cream Dip

Ingredients	percent by weight
Cream	57.00
Skimmilk	7.00
N.D.M.S.	4.50
Swiss Cheese	26.00
Blue Cheese	5.00
Citric acid	.116
Locust bean gum	.170
Dariloid	.170
Salt	.116
Sodium citrate or Di-sodium phosphate	.310
Sorbic acid	.100

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